# The Grounding of the STAR Detector

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The STAR electronics is sensitive to very small electrical signals. For instance, the capacitance of a TPC pad is 30 pf with about 1000 electron RMS noise. Consequently, it was necessary to control the STAR electrical environment so that this noise was not increased significantly.

It is well known that large experiments often have great trouble with noise in spite of superior performance in laboratory tests. A frequent culprit to noise problems is poorly planned electrical distribution. There may be many different and ill-defined electrical paths, resulting in current loops, which in turn produce spurious electrical signals.

Before the STAR Detector was constructed, great care was taken to reduce contributions from the external environment. A careful study was made to plan the electrical distribution so that the sensitive elements are not affected by electrical noise. This grounding plan* required optical connections to the main detector, that the detector be electrically isolated in DC resistance and that the capacitance between the detector and its surroundings be held to less than 5 nf. The schematic for the plan is shown in Figure 1.

Traditionally, experiments only eliminate stray DC resistance and ignore capacitive or inductive effects. The philosophy of a single point ground is attempted, but insufficient care is taken with the detailed routing of the electrical system. STAR Note CSN202A showed that even with modest capacitive effects there could be significant noise induced in the TPC and other detectors in STAR. Therefore stringent specifications were established and communicated to the collaboration.

As the construction of a detector is very complicated and done by many people, we had a significant concern that the grounding plan would be inadvertently violated. Therefore we built a *Ground Integrity Detector (GID)*, a device which checks to see if there is an additional electronic path. The device sends an AC 400 Hz signal current through the ground leads and then checks whether all current is returned. It enables us to have a dynamic determination of the integrity of the ground.

When the detector was installed, the GID showed that there was in fact a stray path to ground. This path vanished when the detector traveled to the Assembly Hall and the fault came back intermittently when the detector returned to the WAH. After much investigation, a small metal chip was found which shorted across a detector insulator

Tests show there is no significant external electrical contribution to the detector noise from the surroundings. Measurements made in December show that even with the magnet operating at full current, the TPC pedestals† are about 1.1 ADC counts, which is approximately the same as measured in the laboratory.

*Footnotes and References*

*H. Matis and D. Jared, Controlled STAR Note 202A found in the documents section of the STAR Web site, www.star.bnl.gov.

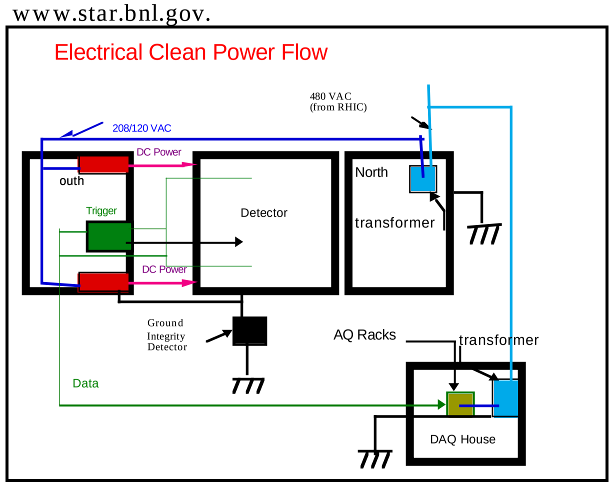


Fig. 1. This schematic shows the grounding of the STAR detector. The location of the Ground Integrity Detector is indicated just below the center of this figure.